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IN THIS ISSUE

Cultivation of Onions in Mysore.

Better and More Oil Seeds.

1943

The

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# The Mysore Agricultural Journal

(The Organ of the Mysore Agricultural and Experimental Union)

Vol. XXI] APRIL—JUNE 1943 [No. 4

## Cultivation of Onions in Mysore

BY

K. Gopala Iyengar and R. S. Iyengar

Of several bulb and root crops raised in the State, the culture of onions is very lucrative and is extensively practised. Occupying as it does, an area of over 14,000 acres, its cultivation is twice in extent to that of potatoes and many times more than that of crops such as sweet potato and garlic.

The area under onions in the State since 1916-17 is as follows:—

| Season | Acres | Season | Acres |
|---|---|---|---|
| 1916–17 | 7,172 | 1928–29 | 7,658 |
| 1917–18 | 6,803 | 1929–30 | 8,322 |
| 1918–19 | 4,755 | 1930–31 | 10,422 |
| 1919–20 | 8,557 | 1931–32 | 10,493 |
| 1920–21 | — | 1932–33 | 17,362 |
| 1921–22 | 8,528 | 1933–34 | 21,498 |
| 1922–23 | 10,420 | 1934–35 | 16,682 |
| 1923–24 | 7,701 | 1935–36 | 15,805 |
| 1924–25 | 13,985 | 1936–37 | 15,112 |
| 1925–26 | 10,206 | 1937–38 | 13,414 |
| 1926–27 | 7,941 | 1939–40 | 13,046 |
| 1627–28 | 6,920 | | |

In spite of considerable fluctuation in the acreage from year to year, the tendency for a gradual expansion of the area till 1934-35, is well marked. In 1934-35, the area under onions reached the peak figure of 21,498 acres; since when, there has been a gradual decline. The increasing use of this commodity by the urban populace and the steady expansion of exports have been responsible for stimulating the cultivation of this crop.

This acreage is evenly distributed in all districts except Shimoga. In the table underneath is to be found, the area in the districts for the period 1930-31 to 1939-40:—

*Area under Onions in the Districts (in Acres)*

| Season | Banga-lore | Kolar | Tumkur | Mysore & Mandya | Hassan | Shimoga | Kadur | Chital-drug |
|---|---|---|---|---|---|---|---|---|
| 1930–31 .. | 469 | 2,687 | 434 | 1,695 | 2,344 | 186 | 548 | 2,059 |
| 1931–32 .. | 330 | 2,233 | 448 | 1,745 | 2,372 | 415 | 1,427 | 1,523 |
| 1932–33 .. | 1,706 | 2,429 | 2,133 | 2,023 | 2,492 | 686 | 3,729 | 2,164 |
| 1933–34 .. | 1,530 | 3,087 | 1,329 | 1,837 | 2,582 | 807 | 4,291 | 2,061 |
| 1934–35 .. | 1,576 | 3,927 | 1,959 | 2,694 | 2,826 | 795 | 5,378 | 2,343 |
| 1935–36 .. | 2,090 | 3,420 | 1,608 | 3,133 | 2,682 | 319 | 1,499 | 1,931 |
| 1936–37 .. | 1,873 | 3,003 | 1,703 | 2,915 | 2,438 | 89 | 1,933 | 1,851 |
| 1937–38 .. | 1,681 | 2,780 | 2,013 | 3,049 | 2,222 | 114 | 1,356 | 1,897 |
| 1938–39 .. | 2,506 | 2,565 | 653 | 2,518 | 2,111 | 80 | 1,101 | 1,880 |
| 1939–40 .. | 2,076 | 2,583 | 736 | 2,671 | 1,784 | 166 | 1,283 | 1,747 |

The following table represents the percentage share of the districts in the total acreage:—

| District | Average of | | | |
|---|---|---|---|---|
| | 1916–17 to 1929–30 | | 1930–31 to 1939–40 | |
| | Acreage | % share | Acreage | % share |
| Bangalore .. .. | 530 | 6 | 1,584 | 11 |
| Kolar .. .. | 1,449 | 17 | 2,871 | 19 |
| Tumkur .. .. | 536 | 6 | 1,302 | 9 |
| Mysore and Mandya .. | 1,439 | 17 | 2,428 | 16 |
| Hassan .. .. | 1,773 | 22 | 2,385 | 15 |
| Shimoga .. .. | 402 | 5 | 366 | 2 |
| Kadur .. .. | 1,038 | 13 | 2,255 | 15 |
| Chitaldrug .. .. | 1,135 | 14 | 1,946 | 13 |
| State .. .. | 8382 | 100 | 15136 | 100 |

Kolar, Mysore and Mandya, Hassan and Kadur have among them about 65 per cent. of the total acreage. During the period 1930 to 1940, the area in Bangalore has nearly trebled in extent and the increase has been almost twice in Kolar. There is an appreciable expansion in all other districts except Shimoga, where the cultivation of onions happens to be gradually getting out of favour.

Onion cultivation is increasingly finding favour in Bangalore District, particularly since 1932-33. The acreage is evenly distributed, Hoskote and Dodballapur being leading centres of production. Of recent importance are Anekal and Nelamangala. Kolar district has the largest area and apart from its concentration in Kolar taluq the remaining area is fairly evenly distributed. In 1924-25, this district returned a record area of 5,826 acres; of which 4,000

was situated in Bagepalli and Gudibanda. Sidlaghatta and Chikballapur are leading centres of cultivation. Since 1930, the taluq of Kolar has spectacularly risen to prominence and is consistently returning maximum acreages. There has been a recent decline in the area in Tumkur district. Pavagada taluq contains the bulk of the area, with Gubbi ranking second.

The distribution of the onion acreage is fairly uniform in the districts of Mysore and Mandya. Nanjangud and Krishnarajpet are old centres of production, and the crop is finding favour to an increasing extent in Mysore, Frenchrocks and Gundlupet. In Hassan district the acreage is very steady and shows the least amount of fluctuation from season to season. In 1924-25, Arsikere had 2,304 acres under this crop. Except in the hilly regions, the crop is widely cultivated. Hassan, Belur and Arkalgud have appreciable acreages. Of late, Channarayapatna and Holenarsipur are growing considerably more onions. Though Hassan and Arkalgud have smallar acreages than the taluq of Kolar, yet, their importance as centres of production is no whit less. Shimoga district is relatively unimportant, the small acreage being mostly confined to Shikarpur and Channagiri.

The acreage in Kadur has had considerable ups and downs, and was 5,378 acres in 1934-35. In that season, Kadur taluq itself had 5,405 acres. The area is very unevenly distributed being mainly confined to Chickmagalur, Kadur and Tarikere. Next to Hassan, the area under onions is very steady in Chitaldrug district. Challakere, Molakalmuru and Jagalur have appreciable acreages. Challakere is a main centre of production and vies in importance with Kolar, Hassan and Arkalgud.

In the onion raising tracts of the State, the annual rainfall varies from 15 to 35 inches, most of it being received from May to the middle of November. The range in temperature is fairly considerable, that of summer varying from 70° F. to 100° F. The winters are comparatively mild, the temperature ranging from 55° F. to 80° F. Though onion prefers a deep friable loam, it is grown on widely different types of soils ranging from sandy loam to black cotton soils. On light and sandy soils, the bulbs attain a large size but an indifferent appearance due to the loose texture of the soil. In addition, these bulbs will not be hard in consistency and are frequently segmented. On heavy and clayey lands, the bulbs will be of good shape, hard and solid, but of small size. To a limited extent the crop is grown in old tank beds, and on the higher reaches of existing tanks where the soil is not water-logged.

In Mysore, two crops are raised during a year, a summer crop and a winter one. Summer plantings take place during the showers of Bharani, Krithike or even Rohini, *i.e.*, in the last week of April and during May; the month of August being the period of harvest. Winter plantings are at the time of *Swathy* rains in October or early in November; the crop being ready for harvest in February or March. While these are widely recognised seasons of planting, a considerable area is planted both prior and subsequent to the periods mentioned above. Here and there, small areas are planted with onions in July, as a rainfed crop. The winter crop is the main crop accounting for over 60 per cent. of the annual acreage. But, in the districts of Bangalore and Kolar, the summer crop is planted over a wider extent than the winter one. This is due to the fact that in winter, land which would be otherwise devoted to onions is planted with

potatoes, chillies, cabbages, etc., crops whose net returns are almost equal to that of onions. The average yield per acre roughly amounts to 15,000 lbs. or 525 maunds (maund = 24 lbs.). The mean yield of the summer crop is about 12,500 lbs. or 520 maunds. and that of the winter one 17,500 lbs. or 730 maunds per acre.

In its early stages, onion requires comparatively mild temperatures, but warm moist conditions later on. High temperatures associated with abundant supplies of water, hinder the formation of bulbs and their subsequent development. While the winter crop obtains these favourable conditions, the summer crop happens to be a hot weather crop which matures its bulbs during the rainy months of July and August. As a consequence of this, the yield of the winter crop exceeds that of summer by about 30 to 40 per cent. Apart from its heavier yield, the winter crop is much favoured on account of the following reasons. The bulbs being harder, keep better in storage, and the loss in weight due to driage, is also comparatively less. The winter crop which appears on the market in February and March is very much in demand for export purposes. Of the exports from the State 50 per cent. is sent out during the quarter, January to March and an additional 30 per cent. in the next three months. The share of the summer crop in the exports amounts to just under 20 per cent. Consequently, the prices realized for the winter produce are more favourable than that obtained for the summer one. In addition, for purposes of seed production, bulbs of a previous winter crop are used, exclusively.

The crop is usually raised under irrigation, tanks and wells forming the main source of supply. Water is generally lifted by *picottahs* or *mhotes* and occasionally by power-driven outfits. As the summer crop enjoys the benefit of the pre-monsoon showers and the south-west monsoon, it requires a lesser amount of irrigation than the winter crop. In a few parts of the State, as round about Hunsur, Arkalgud, Goribidnur and Malur, onion is raised as a dry or rainfed crop. The returns from such a crop are highly uncertain and usually low, rarely exceeding 2,500 lbs. or 175 maunds.

Local trade recognises two varieties of onions, the Local and the Bellary. Local onions are small to medium in size, hard and round, flesh-coloured and of good keeping quality. Bulbs of Bellary onion are much larger, light- to dark-red and not so hard as the local one. In each of these two varieties, several additional types can be distinguished. The local contains two such types. One is of a darker red colour producing a much segmented bulb; resulting in a cluster of small oval bulbs united at their base. A second type known as potato or runner onion, multiplies in a manner very similar to that of potato and usually does not produce any flowers. Very often, the local contains a small percentage of white or ivory-skinned bulbs, with or without a reddish flush on their necks. In Bellary onions a white bulb type is also recognised. This white type produces flattish bulbs of a slightly smaller size.

Onion is a crop which requires intensive cultivation and since most operations are performed by manual labour, the extent of the crop on individual holdings rarely exceeds half an acre. Those that plant larger areas, generally do so either on *Vara* or share cropping basis or most of the cultivation operations are performed by bullock-drawn implements. The latter practice is much

prevalent in portions of Hassan and Chitaldrug districts. The crop can be raised by three methods, by seed, by transplanting seedlings or by bulb sets or thumb bulbs.

The cultural operations for onion as a dry crop are very similar to those adopted for *hain* ragi, except that the application of manure is more liberal. Seed is invariably drilled in rows about a foot apart during July. The harvest takes place late in October or early in November, either by passing a plough between the rows or by digging up the bulbs by hand. The yield is extremely variable, ranging from 60 to 180 maunds of 24 lbs. each.

For an irrigated crop, preparatory cultivation of the land commences about six weeks prior to planting. The land is either given a deep ploughing or dug by hoes to a depth of a foot and allowed to remain as such for about three weeks. The plot is again ploughed or turned over by hand hoes, this time to a depth of about six to eight inches. The land is now harrowed, the manure broadcast and the plot stirred, levelled and made ready for planting. The application of farmyard manure or town sweepings is at the rate of 15 to 20 cart-loads per acre. In parts of Chitaldrug, Hassan and Mysore, sheep-folding is frequently resorted to. The plot is now marked out into a series of beds, water channels laid and drains provided. These beds are of two kinds, flat and ridged. The flat beds are usually 2 ft. by 3 ft. or 3 ft. by 3 ft. in dimension. The ridged beds are of a larger size, generally 12 ft. by 3 ft. or 20 ft. by 3 ft., the ridges being a foot apart. Frequently, the application of manure takes place after the beds are marked; the manure being worked into the beds. Wherever available, wood ashes always supplement farmyard manure. In case onion follows potatoes or cabbages, neither the preparatory cultivation is so thorough nor the application of manure so generous.

In case the crop is directly raised from seed, it is always done so on flat beds; for purposes of seed production the ridged beds are invariably employed. Both types of beds are in vogue, when the crop is started by seedlings or bulb sets. The ridged beds produce a heavier crop of large-sized bulbs where, as on flat beds, the yield will be less and the bulbs smaller in size. Bulbs from flat beds will be of uniform size and shape, hard and round; that from raised beds varies much in size and shape, is not of a firm consistency and frequently segmented or split up. It is obvious that what the produce from flat beds loses in quantity it very nearly makes up in quality. On light and medium soils the flat bed is preferable and ridged beds when the soil is clayey or heavy in texture.

Very good onions for the market are produced by planting small bulbs or setts or thumb bulbs as they are otherwise known. This is the most prevalent method adopted in the State for the raising of this crop. The produce obtained from sett plantings is generally believed to be not only of better quality and size but also less variable for these traits than that obtained from seed or by transplanting seedlings. The planting material or sett is derived from many sources. Frequently small bulbs of a previous crop are used as planting material for the next crop. Small bulbs produced when onion is raised as a dry crop are highly valued as planting material. Large quantities of these setts are obtained from places like Hunsur, Hassan, Arkalgud and Malur. When

nurseries are raised for transplanting seedlings, the surplus seedlings are allowed to partially develop and are subsequently used as planting material. Recently obtained setts are never used, they are always planted after undergoing a rest of eight to twelve weeks.

The seed rate is about 1,000 lbs. or 40 maunds, often as high as 60 maunds if the setts are of larger size. In flat beds these are planted in rows, about six inches apart, and at a distance of three inches from sett to sett in the row. When beds are ridged, the setts are placed on either side of the ridge at a distance of about three inches. Usually the flat beds will have been irrigated before planting and the ridged beds are irrigated immediately after the setts are put in. Water is usually withheld till sprouting is general. A watch is always necessary to scare away birds from consuming the tender sprouts. Subsequent irrigations are light and are given at intervals of five days for about six weeks. While the crop is growing, one or two weedings may be necessary. In case of rank vegetative growth the shoots are usually trampled down in fine weather, never when the ground is wet. This operation may be repeated again in case of necessity. When the crop is about seven to eight weeks old, it is earthed up in ridged beds. When the bulbs are developing, the irrigations are heavier and more frequent if found necessary.

The maturity of the crop is indicated by the leaves and stalks turning yellow. If before this, the onion bolts, *i.e.*, produces flowering stalks, these should be promptly removed. If the flowers are allowed to develop, the bulbs become irregular in outline, develop fibrous scales and lose their keeping quality. These flowering shoots or poles find a ready market as a green vegetable. Frequently a plank is dragged across the rows thus breaking these flowering stalks. This operation is known as breaking the neck. To hasten maturity and harden the bulbs irrigation is usually stopped about a fortnight before harvesting, and the tops are trampled down. This trampling down before harvest is only done in the case of a winter crop. A summer crop should never be trampled as it will injure the bulbs and lower their quality. In case of necessity, the beds are irrigated a day or two before digging up the bulbs. After the bulbs are pulled out they are left north to south in the row for about a week or a week and a half to be cured. Afterwards the roots and shoots are trimmed and the produce carted away to the market. The yield varies from 500 to 800 maunds, now and then as high as 1,000 maunds of 24 lbs. each.

The method of raising a crop of onions direct from seed is very prevalent in the districts of Bangalore and Kolar, particularly as a summer crop. Onion seed used either for raising a crop directly, or for sowing in the nursery, should always be of good quality and be obtained from a reliable source. Since onion seed looses its viability very soon, as the cost of the seed is fairly high and as poor quality seed at best produces an indifferent crop, it always pays to obtain the best seed available on the market. Seed should never be more than a year old and should give a germination per cent. of at least 75. If possible, it is always best for the grower to produce his own supply of seed as and when necessary. Before sowing, the seeds are rubbed with ash and dried in the sun. Seed is broadcast into flat beds at the rate of 10 to 12 seers per acre. After sowing, the seeds are raked into the soil and the beds are gently rolled

or trod over. The beds are immediately splashed with water and subsequent irrigations are given at intervals of five days.

In about a week the seedlings appear and these are to be carefully protected from the depredation of birds. If a crop of small bulbs is required, only a little thinning will be necessary. To obtain medium-sized bulbs, the beds are thinned about three weeks after sowing and if necessary a second thinning is given a fortnight later. These thinned-out seedlings find a ready sale in the market as a green vegetable. Subsequent cultural operations are similar to that employed for a crop raised from setts. The yield varies from 400 to 600 maunds, the average being 450 maunds.

Raising a crop by transplanting seedlings is widely practised in the Chitaldrug district. Good seed is sown in nursery beds at the rate of 3 to 4 seers per acre. The nursery beds are prepared with great care and receive a heavy dressing of manure at the rate of 40 cartloads per acre. About two guntas of nursery is necessary to transplant an acre. The nursery is divided into beds of about 12 ft. by 3 ft. into which the seed is either broadcast or sown in shallow furrows, 3 to 4 inches apart. When good seed is sown in rows, much economy in seed rate is possible, about a seer and a half being found sufficient for an acre. The nursery is lightly watered regularly and the seedlings protected from birds. Frequently, when the plants are 3 to 4 weeks old the tips of the seedlings are pinched off as this is believed to thicken them. Seedlings are transplanted into beds when they are about a month and half old. Subsequent cultivation operations are the same as in the case of a crop raised by setts. The yield ranges from 500 to 700 maunds, being about 600 maunds on the average.

Onion seed is frequently produced by allowing a few plants that have flowered to develop and set seed. Apart from the ease and the cheap cost at which the seed is procured, this method has nothing to recommend it, as at best the seed produced is of an indifferent quality. For production of quality seed, choice bulbs of the previous winter crop are planted in ridged beds. A crop of onion for seed is invariably a winter crop. These selected bulbs are preserved in plaited wicker works, kept on a raised platform. Inside these containers which are known as "puri", the bulbs are kept in an inverted position with their roots intact. The puri is opened just at the time of planting and the bulbs are planted in the furrows at a distance of 9 to 12 inches. An acre requires about 1,500 to 2,000 lbs. of seed bulbs. Frequently a quarter of the bulb at the top is sliced off before planting. In case the bulbs are large, in addition to this slicing, they are also slit vertically. These cuts extend almost to the base of the bulb; a single cut will suffice for a medium bulb, whereas for a large bulb two cuts are necessary, the second being at right angles to the first. The slicing off of the tip of the bulb is supposed to induce early and uniform sprouting and the slitting of the larger bulbs to increase the number of flowering heads.

Cultivation methods are similar to those adopted in the case of setts planted in ridged beds. The plants are not trod down in case the foliage becomes rank and the flowering shoots are allowed to develop and set seeds. Flowers begin to appear 6 to 7 weeks after planting and continue to do so

for a period of two months more. The open flowers require a further period of 9 to 10 weeks to set seed and ripen. Seeds should be promptly gathered from individual plants as and when they ripen. When the ripe black seeds show out, the heads are cut off with a length of stalk, dried in the sun for a few days, the seeds separated and stored in a dry place. Seeds obtained from early flush of flowers are supposed to be of a superior quality, and if possible ought to be kept separate. The yield per acre is about 250 to 300 seers of seeds. The plot, also yields about five to six thousand pounds of bulbs of an inferior quality.

After harvest, if the onion bulbs cannot be cured in the field, either due to inclement weather or due to want of safety, they can be brought indoors, and spread in a thin layer on the floor in a well ventilated place. In cases, where the area grown is very small, the bulbs, along with the shoots, can be braided into ropes of suitable length and suspended from the ceiling to cure gradually.

Onion generally does not enter into any definite schemes of rotation. Frequently, a crop of onion either precedes or succeeds a crop of potato, chilly, brinjal, cabbage, irrigated ragi or even groundnut. Often it is grown as a mixture along with leafy vegetables and root crops like radish and garlic. To some extent it is taken as a catch crop in orchards and young plantations of cocoanuts. It is also possible to raise it as a catch crop between rows of young sugarcane.

The cost of cultivation and the return from this crop vary from holding to holding and it is exceedingly difficult to obtain exact estimates.

The following estimates of cost of cultivation and the net return per acre are purely tentative.

Onion for production of seed is grown on small patches rarely exceeding a *gunta* or two in extent. As part of the manure and most of the labour employed in raising the crop, is furnished by the cultivator and his household, the actual returns are much more than what has been indicated in the preceding table.

The uses of onion are well known and it is superfluous to recapitulate them here. Dried onions and onion powder have recently made an appearance in the market.

There exists a considerable local trade in onions at the weekly fairs held in villages and small towns. The main assembling centres for the wholesale market are Bangalore, Malur, Chikballapur, Vadigenahalli, Hassan and Challakere. A considerable portion of the produce of Bangalore and Kolar districts is exported direct to Madras ports and then on to Burma and Ceylon. The average production in Mysore amounts to about twenty lakhs of railway maunds. In addition, about a lakh of maunds is imported annually into the State. Yearly exports approximate to about two lakhs of maunds, thus leaving nearly nineteen lakhs of railway maunds for consumption within. Bulk of the import arrives from the province of Madras and most of the exports are destined to Madras ports. The imports are valued at a lakh and a half to three lakhs of rupees and exports are worth three to six lakhs. The source and destination of the foreign trade and its periodicity are shown in the table.

| Cultural operations, etc. | Crop raised from seed | | | Crop raised from setts | | | Crop raised from seedlings | | | Crop raised for seed | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rs. | A. | P. | Rs. | A. | P. | Rs. | A. | P. | Rs. | A. | P. |
| Preparatory cultivation | 15 | 0 | 0 | 20 | 0 | 0 | 20 | 0 | 0 | 20 | 0 | 0 |
| Manure & its application | 20 | 0 | 0 | 20 | 0 | 0 | 20 | 0 | 0 | 20 | 0 | 0 |
| Planting material— | | | | | | | | | | | | |
| Seed .. .. | 25 | 0 | 0 | .. | | | .. | | | .. | | |
| Setts .. .. | .. | | | 40 | 0 | 0 | .. | | | .. | | |
| Seedlings including nursery charges .. | .. | | | .. | | | 25 | 0 | 0 | .. | | |
| Seed bulbs .. | .. | | | .. | | | .. | | | 60 | 0 | 0 |
| Sowing or planting .. | 2 | 8 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 5 | 0 | 0 |
| Irrigation .. .. | 30 | 0 | 0 | 30 | 0 | 0 | 30 | 0 | 0 | 30 | 0 | 0 |
| After cultivation .. | 10 | 0 | 0 | 12 | 0 | 0 | 12 | 0 | 0 | 12 | 0 | 0 |
| Spraying .. .. | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Harvesting .. .. | 5 | 0 | 0 | 6 | 0 | 0 | 6 | 0 | 0 | 4 | 0 | 0 |
| Collection of seed .. | .. | | | .. | | | .. | | | 16 | 0 | 0 |
| Assessment .. .. | 2 | 8 | 0 | 2 | 8 | 0 | 2 | 8 | 0 | 2 | 8 | 0 |
| Watch .. .. | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 7 | 8 | 0 |
| Marketing charges .. | 10 | 0 | 0 | 10 | 8 | 0 | 10 | 8 | 0 | 3 | 0 | 0 |
| Total cultivation charges | 130 | 0 | 0 | 155 | 0 | 0 | 140 | 0 | 0 | 185 | 0 | 0 |
| Yield per acre in mds. | 450 | | | 700 | | | 600 | | | 250* | | |
| Seed in seers .. | | | | | | | | | | 250 | | |
| Approximate value of bulbs @ As. 6 per maund and seed @ Rs. 2 per seer .. | 169 | 0 | 0 | 262 | 0 | 0 | 225 | 0 | 0 | 550 | 0 | 0 |
| Less cultivation charges | 130 | 0 | 0 | 155 | 0 | 0 | 140 | 0 | 0 | 185 | 0 | 0 |
| Net return per acre .. | 39 | 0 | 0 | 107 | 0 | 0 | 85 | 0 | 0 | 365 | 0 | 0 |

* These bulbs of inferior quality have been valued at 5 maunds per rupee.

*Source and Destination of Foreign Trade* *Periodicity of Foreign Trade*

| | Import % | Export % | Period | Import % | Export % |
|---|---|---|---|---|---|
| Madras province .. | 90–92 | 12–14 | January–March .. | 48 | 50 |
| Bombay .. | 6—8 | 1—2 | April–June .. | 20 | 30 |
| Madras ports .. | | 84–88 | July–September .. | 10 | 5 |
| Other places (chiefly Hyderabad) | 1 | | October–December | 22 | 15 |

Since onion does not keep long in storage, the price of this commodity in the market depends upon the available supply and the demand for it. Supplies being plentiful at the time of harvest and immediately after, prices are usually

low. The price increases as the supply diminishes till the next harvest again lowers the price. As a consequence of two harvests appearing on the market during the course of a year and the considerable latitude obtained in planting dates, the supplies for the market are fairly steady and the fluctuation in prices is not violent. The following table furnishes a rough idea regarding the nature of supply, price and its index:—

*Average of* 1941-1942

| Month | Local Onion | | | Bellary Onion | | |
|---|---|---|---|---|---|---|
| | Index of price | Supply | Maunds per rupee | Index of price | Supply | Maunds per rupee |
| January .. | 100 | Moderate | 1·50 | 100 | Poor | 1·25 |
| February .. | 60 | Abundant | 2·50 | 80 | Moderate | 1·75 |
| March .. | 60 | ,, | 2·75 | 70 | Abundant | 2·00 |
| April .. | 60 | ,, | 2·50 | 70 | ,, | 1·75 |
| May .. | 100 | Moderate | 1·50 | 115 | Moderate | 1·25 |
| June .. | 120 | Poor | 1·25 | 150 | Poor | 0·88 |
| July .. | 120 | ,, | 1·00 | 150 | ,, | 0·88 |
| August .. | 100 | ,, | 1·25 | 160 | ,, | 0·80 |
| September .. | 85 | Moderate | 1·75 | 150 | ,, | 0·75 |
| October .. | 85 | Abundant | 1·75 | 130 | ,, | 1·00 |
| November .. | 85 | ,, | 2·00 | 105 | ,, | 1·25 |
| December .. | 60 | ,, | 2·25 | 80 | ,, | 1·65 |

Onion is attacked by comparatively few pests and diseases.* No pests are found to attack the bulbs in storage. The only serious pest attacking the crop in the nursery and in the field is a species of thrip, *Thrip tabaci* L. This is a minute insect which multiplies at a very rapid rate. It sucks the sap from the stem and leaves, causing whitish blotches. A serious attack causes the parts to turn brown and wither, destorting the bulbs and making them undersized. Remedial measures consist in dusting with fine tobacco dust sand or spraying with tobacco decoction. The decoction can be made by soaking over-night a pound of dry leaf in a gallon of warm water and subsequently diluting with an equal quantity of cold water. After dissolving 2 ounces of soap in this, the decoction is ready for spraying. A minor pest often found on onion is a species of Aphid, which can be destroyed by a spray of hongey oil soap (1 lb. in 10 gallons of water).

Of the diseases attacking the standing crop, a leaf-spot due to a species of *Macrosporium* and smut caused by *Urocystis cerulæ* are of some importance. These can be controlled by a spray of 1 per cent. Bordeaux mixture. Considerable loss is sustained by bulbs in storage due to a kind of bacterial rot, humid weather aggravating the loss sustained.

The belief is widely held that a crop of onion proves very beneficial to the succeeding crop. This is supposed to be the result of a crop of onion destroying all the vermin harboured in the soil.

* Based on information kindly furnished by the Entomologist and Micologist of the Department of Agriculture, Mysore.

# Spraying of Crops against Fungoid Diseases in Mysore

BY

**S. V. Venkatarayan**

Plants of the field and garden have their own diseases like human beings and animals. They have got to be protected against these to ensure satisfactory crops and one of the steps is spraying with a liquid chemical. This is really a method of disinfecting or protecting the parts of plants.

This disinfection or spraying came into practice in the Mysore State in the year 1908 in connection with the *Koleroga* or rot disease of arecanuts. This disease causes a nut-fall during the south-west monsoon rains in the heavy rain tracts adjoining the Western Ghats, popularly called the *Malnad*. It is also prevalent in the neighbouring districts of North Kanara (Bombay) and South Kanara and Malabar (Madras) and in the States of Cochin and Travancore. In Mysore alone it causes approximately an annual loss of four lakhs of rupees.*

The disease is caused by a minute vegetable parasite called a fungus similar to the growth common in rainy weather on the leather backs of books, and on boots and shoes and rotting vegetables. The fungus enters the nuts from outside, aided by the driving rain and wind, and causes a decay of the kernel. If the nuts had a protective coat the fungus would have been prevented from entering the nuts.

The first thing that suggested itself to the garden owner was to provide a hood to the bunches of nuts so as to keep away the rain in much the same manner as an umbrella keeps the rain off his head. The hood or *Kotte* was made out of the sheathing bases of the leaves of the areca palm itself stitched with split bamboo pins and tied over the bunches, one to each bunch, with plantain fibre. The materials for the *Kotte* are readily available in the garden or in the immediate neighbourhood but many a time the sheaths of one garden are not sufficient to protect the bunches in that garden. Then the owner has to purchase the balance of *Kottes* from his neighbour at great cost. The preparation of the *Kottes* takes a great deal of labour, already scarce in the *Malnad*, which has to be provided by the owner's family. It is a common sight to see the garden owner and his wife and children and grandchildren and any available hired labour sitting all hours of the day and night patiently making the *Kottes*, with only a little respite for food. The tying of the *Kottes* (see Fig. 1), which is nothing short of an acrobatic feat, has similarly to be done by whatever hired labour is available or by the owner himself. Having tied the *Kottes* on the areca bunches the garden owner has nothing to do but to pray that the wind and rain may not be severe and blow off the *Kottes*. Any man that has held

* Since the value of the produce has increased considerably in recent times, the loss is likely to be three or four times this figure.

an umbrella in the pouring rain of the *Malnad* knows how much protection it gives to his head and in the case of the areca bunch the result is not far different. A few *Kottes* are blown off by the wind, a few rot in the rain, and a few may still be seen dangling from the bunches at the height of the monsoon. In short, the protection afforded to the bunches is very little and out of proportion to the time and labour involved in the process. It does not stop with that, however, for the *Kotte* is a positive source of danger to the arecanut bunches. The *Koleroga* fungus, besides attacking arecanuts, attacks also the tops of the palms, where it causes a bud rot and also a rotting of the sheathing bases of the leaves. When the leaves fall down and are gathered for future use the fungus lives in a dormant condition in the sheaths, and revives when rain falls. So when the sheaths are used for *Kottes* the fungus, on germination, gets just the proper place to start the next generation.

What should rationally be done then is to rid the garden and its surroundings of all infection. The fallen nuts should be gathered and burnt or buried deep, as also other debris consisting of the fallen bunches, flower spathes, leaves and leaf-sheaths. These should on no account be stored near the garden, but used for fuel immediately after collection and drying. Weeds in the garden and other plants in the fence or round about, which are likely to harbour the fungus, like *Colocasia antiquorum, Bryophyllum calycinum, Jatropha curcas, Loranthus longiflorus,* wild fig (*Ficus hispida*), should be destroyed. Other useful tree like Jack (*Artocarpus integrifolia*) and Sandal (*Santalum album*) also harbour the fungus, but they cannot be destroyed in the same manner as these weeds. However, a watch should be kept on them lest the disease should get severe. Dead areca palms and cocoanut palms, if any, should not be left standing in the garden, but their tops with a portion of the trunk should be cut and burnt.

The next and the most important thing to do is to give the bunches a protective coating (see Fig. 2). This is done by spraying the bunches with a mixture of solutions of copper sulphate and quicklime called Bordeaux mixture after the town in France, where its use was accidentally discovered between the years 1882 and 1885 by the great scientist, Millardet. But the mixture now used against areca *Koleroga* is different in composition from that prescribed by Millardet against Downy Mildew of grapes. This mixture contained nearly three times the quantity of copper sulphate and six times the quantity of lime that are contained in the mixture used against areca *Koleroga.*

The mixture used against areca *Koleroga* is the two per cent. Bordeaux mixture, because it contains two parts of copper sulphate in every 100 parts by weight of water. Two sprayings are necessary, one to be done before the rains of the south-west monsoon, towards the end of May or early in June. The nuts at this time are not usually fully developed and considering also that all the three or four bunches that are usually found in each palm are not formed at the same time, another spraying after an interval of one and a half to two months should be done. This spraying not only gives protection to the earlier undeveloped portions of the nuts and the later-formed bunches but also serves to protect those earlier-sprayed portions from which the mixture would have been washed off by the driving rain and wind. Moreover at this time of the second spraying the disease is prevalent all over and hence the second spraying is even

FIG. 1. Kotte

FIG. 2. Spray

more necessary than the first. The first spraying prevents the start of the infection while the second prevents its spread. There are some garden owners who go to the length of spraying even three times when the infection is severe.

The Bordeaux mixture consists of:—Copper sulphate 5 lbs., Quicklime 5 lbs., Water 25 gallons.

Out of this volume of water one gallon is reserved for preparing the adhesive. Five lbs. of copper sulphate is dissolved in 12 gallons or 48 *pucca* seers of water in a wooden, copper, brass or earthen vessel (iron or zinc vessels should not be used), by tying it up in a bag of cotton or jute cloth and suspending it from a stick placed across the top of the vessel, so that the bag just touches the water.

Five lbs. of well-burnt stone lime is slaked with a little water, and then made up to 12 gallons or 48 *pucca* seers.

The copper sulphate solution is slowly poured into the lime solution accompanied by stirring. A mixture of a beautiful sky blue colour results. Lime is apt to contain stones and it sometimes happens that the mixture contains an excess of copper sulphate due to imperfect neutralization. Excess of copper sulphate, if present, may be detected by dipping the end of a polished knife blade into the mixture for a minute, when the blade will show a coppery brown deposit. In such a case more lime solution should be added till a polished blade remains bright when dipped into the mixture.

The adhesive used in the earlier years was Resin-soda. Resin-soda is prepared by boiling 2 lbs. of Resin and ½ lb. of soda ash in one gallon of water till the mixture is quite clear. This will take about one hour. This is added to 24 gallons of Bordeaux mixture as prepared above, accompanied by stirring.

Since Resin-soda entails some trouble in its preparation, another adhesive called lime-caseinate was introduced. Half a pound of fine-ground Casein is soaked in half a gallon water and to this is added ½ lb. lime slaked in half a gallon of water, attended by stirring. The Casein dissolves in about quarter of an hour.

In place of Resin-soda or lime-caseinate, cheap vegetable oils may also be used as adhesives. These are, in addition, supposed to increase the fungicidal efficiency of the Bordeaux mixture. Oils like groundnut oil, gingelly oil or cocoanut oil are added to the copper sulphate solution itself at the rate of half *pucca* seer for 25 gallons of the mixture. On mixing with the lime solution a sort of emulsification of the oil results.

During recent years a Resin paste or Potash-resin-soap added at the rate of 2 lbs. to every 25 gallons has been found to be a very good spreader and adhesive. Owing to the scarcity of Casein and its high cost on account of the heavy demand for it in the plastics industry, the Potash-Resin soap is coming to replace Casein as an adhesive.

Since there is a heavy demand for copper sulphate it is time to think of ways of reducing the cost of spraying. During the years following the first World War, when copper sulphate was costly, Potash alum was used in part to replace a little of the copper sulphate in Bordeaux mixture. In Mysore, in

place of 5 lbs. of copper sulphate in 25 gallons of water, 2 lbs. copper sulphate and 2 lbs. Alum were used. This mixture proved beneficial, but with the return to normal conditions it fell into disuse.

Two per cent. Bordeaux mixture is a fairly strong concentration to use, but considering the fact that the regions where areca *Koleroga* prevails are visited by a heavy south-west monsoon, its use was justified in the early stages. It may now perhaps be used at half strength, *viz.*, 1 per cent., in many of the gardens, whereby there will be a saving of approximately half on the value of the chemicals. It should be noted, however, that while the copper sulphate and lime may be cut down by half the adhesive must remain at the same strength, because of the volume of water used. In this connection it may be worth while to remember that the spraying experiments against coffee black rot also started with 2 per cent. Bordeaux mixture, but in actual practice 1 per cent. was found to be enough. The planters soon felt the need of economy when having to handle large acreages and with falling prices of coffee. Many coffee estates now use only one-half per cent. Bordeaux mixture, while some use one-quarter per cent. Bordeaux and still find that spraying gives adequate control against leaf-disease and die-back.

## Schedules in Connection with the Production of Better and More Oil Seeds in Villages

**(*Contributed by the Botanical Section*)**

The crops generally spoken of as oil seeds, are important cash crops to the dryland farmer of the State. On an average, over seven lakhs of acres come annually under these crops, representing slightly more than one-tenth of the total area brought under plough in Mysore.

Groundnut, cocoanut, castor, cotton and gingelly are major sources of oil, and altogether occupy nearly ninety-five per cent. of the total area under oil seeds. Niger, mustard, safflower and others, like linseed, poppy, etc., contribute to the remaining five per cent. of the acreage. This excludes other sources of oil like *hongey, neem* and *ippe,* which are derived from forests, plantations and avenue trees.

The average area under the important oil seeds is as follows:—

| Oil seed | Acres | % of total area under oil seeds |
|---|---|---|
| Groundnut .. .. .. | 240,789 | 33·3 |
| Cocoanut .. .. .. | 160,531 | 22·3 |
| Castor .. .. .. | 102,928 | 14·3 |
| Cotton .. .. .. | 82,029 | 11·3 |
| Gingelly .. .. .. | 79,173 | 10·9 |
| Niger .. .. .. | 16,234 | 2·2 |
| Mustard .. .. .. | 4,941 | 0·7 |
| Other oil seeds .. .. .. | 35,610 | 5·0 |
| Total Area .. | 722,235 | 100·0 |

Groundnut is by far the most important source of oil. Large quantities of it are crushed and there is a considerable export trade in kernels, oil and seed. Cocoanut, in spite of the large acreage under it, is not a commercial source of oil. About half of the produce is consumed as green nuts and the other half made into copra. Most of the copra made in Mysore is an edible one and its high price precludes it from being used for crushing purposes. There exists a flourishing export trade of this edible copra. Considerable quantities of nuts, copra and oil are also imported annually. Castor is an other important source of oil and the local mills crush a fair quantity of it. Much of both the oil and the cake is exported. Cotton seed as a source of oil is hardly of any importance. The seed is primarily used as cattle feed, and large quantities of it are also exported. Gingelly is locally crushed and the oil produced is not of sufficient quantity to meet local demands. The production of Niger is very small in quantity and all of it is locally absorbed. Mustard is used more as a condiment than as a source of oil.

The Department of Agriculture is distributing several improved varieties of groundnut and castor. Seed nuts and seedlings of cocoanuts from selected mother plants are also offered to the public at concession rates. It is hoped to release improved strains of other oil seeds in the near future.

Requests for the supply of these improved varieties should be addressed to the Director of Agriculture in Mysore, Bangalore, when supplies are desired outside the State. Indents for local supplies should be made to the Deputy Director of Agriculture in Mysore, Bangalore, or to the respective Assistant Directors.

## Schedules

The following schedules deal with the salient features of these improved varieties, and it is hoped that these schedules will be of guidance to all interested in the steps to be taken for the production of more and better oil seeds in villages.

### Groundnut

(*a*) *Variety* H.G. 1

1. *Chief Merits—*
   - (*a*) H.G. 1.—a hybrid, an erect strain and a high yielder.
   - (*b*) Pods are of medium size possessing an attractive appearance.
   - (*c*) As the pods have long stalks, damage to the ripening crop by crows is not very severe.
   - (*d*) When the crop is nearly ripe, the seeds do not germinate during wet and inclement weather.
   - (*e*) It is drought-resistant and does not severely suffer from leaf spot disease.

2. *Where Recommended—*

   On light and medium soils throughout the State.

3. *Cultivation—*

   Groundnut cultivation being an established practice, needs no special stress. The new variety also does not require any departure from local practices of cultivation. Seed rate is 100 seers of unshelled nuts. Sowing season is early May and July.

4. *Seed Supply—*

   The quantity of seed required must be intimated early in February or March to the Deputy Director or to the Assistnat Directors.

5. *Other Particulars—*

   Isolated from a natural hybrid between Spanish and Big Japan. Erect in habit forming a compact bush. Leaves are small and dark-green. Duration of crop—4½ months. Average yield—about 1,000 lbs. of nuts in shell. Pods—2 to 3 seeded, medium in size, constriction and beak not pronounced (3-seeded pods about 25 per cent.; 2-seeded about 55 per cent.; and one-seeded about 20 per cent.). Shelling percentage 70 to 73 per cent. by weight. Kernels medium in size and light rose in colour. Total oil content 48-49 per cent. (moisture-free basis). Acidity—0·3 to 0·4 per cent. Extensively grown in Hyderabad and Madras.

(*b*) *Variety* H.G. 3

(*known as G. 0173 in Departmental trials*)

1. *Chief Merits*—
   (*a*) This is an erect strain, high yielding and early.
   (*b*) Pods are of medium size and of an attractive appearance.
   (*c*) Is fairly drought-resistant.
   (*d*) Being a vigorous strain, it yields a greater amount of haulms than other erect varieties.

2. *Where Recommended*—
   Chitaldrug District; Honnali and Channagiri in Shimoga; Tarikere and Kadur in Kadur District; Arsikere in Hassan; T. Narsipur, Chamarajanagar and Gudlupet in Mysore. Also as a catch crop in paddy lands during summer.

3. *Cultivation*—
   The usual cultivation practices are adequate. Seed-rate—100 lbs. of pods in shell. Sowing season—early May or in July.

4. *Seed Supply*—
   Apply to the Economic Botanist, Department of Agriculture, Bangalore.

5. *Other Particulars*—
   (*a*) A hybrid between Spanish and Barbadoes.
   (*b*) Erect and vigorous in habit.
   (*c*) Duration of crop—4 months; same as Spanish.
   (*d*) Average yield—900 to 1,000 lbs. nuts in shell.
   (*e*) Pods medium in size, smooth, 2- to 3-seeded, constriction and beak not pronounced.
   (*f*) Shelling percentage—70 to 72 by weight.
   (*g*) Kernels medium and pale-rose in colour.
   (*h*) Total oil-content—48 to 49 per cent. (moisture-free basis).

6. *General Remarks*—
   H.G. 3 will give a yield of 100 to 200 lbs. of pods over Spanish and also result in a larger amount of haulms. In addition, the pods are larger than Spanish, containing many three-seeded pods and hence present a much better appearance. It is anticipated that H.G. 3 will entirely replace Spanish.

## Cocoanut

*Varieties—Selected Local Strains*

1. *Chief Merits*—
   Nuts from selected mother-plants growing in Arsikere, Tiptur and Chikkanaikanahalli regions and seedlings raised from these.

2. *Where Recommended*—
   Throughout the State wherever adequate water facilities are available to raise a garden.

3. *Cultivation*—
   Cultivation practice—normal.

4. *Seed Supply*—
   The seedlings are available at a concession rate from Government Farms and may be procured through the Assistant Director or by writing to the Officer-in-Charge of Government Farms situated at Hebbal, Babbur and Irwin Canal area.

Requests for seed nuts may be communicated to the Deputy Director of Agriculture.

### Castor

#### (*a*) *Varieties* L. 53, L. 54 and L. 242

1. *Chief Merits*—
   (*a*) Height 6 to 8 feet, much branched.
   (*b*) Green stem with bloom.
   (*c*) Spikes many and short capsules medium.
   (*d*) Drought-resistant.
   (*e*) Give fair yields even in unfavourable seasons.
2. *Where Recommended*—
   Suited to areas of scanty rainfall. Chitaldrug, Mysore and Tumkur and Kolar Districts. Closepet and Kankanhalli in Bangalore District.
3. *Cultivation*—
   Usual methods adopted locally.
4. *Seed Supply*—
   Indents to be made early in March to the Deputy Director or the Assistant Directors.
5. *Other Remarks*—
   Selections of local castors. Duration of crop 6 to 8 months. Seeds of medium size. Average yield 250-300 lbs. Oil content 47 per cent. (moisture-free basis). Seed rate is 12 to 16 lbs. for a pure crop.

#### (*b*) *Varieties* L. 73, L. 74 and L. 77

1. *Chief Merits*—
   (*a*) Vigorous, tall, height 10 to 12 feet, branches few.
   (*b*) Red stem with bloom.
   (*c*) Spikes few and long, capsules large.
   (*d*) Early maturing.
   (*e*) Give heavy yields in favourable seasons.
2. *Where Recommended*—
   Suited to areas of medium rainfall, Shimoga, Hassan, Kadur and irrigated tracts of Mandya District.
3. *Cultivation*—
   Local methods.
4. *Seed Supply*—
   Requests for supply to be addressed to the Deputy Director of Agriculture or to the Assistant Directors, early in March.
5. *Other Remarks*—
   Selections from Mattihalli castors. Duration of crop 4½ to 6 months. Spikes 12 to 18 inches long, and densely covered with capsules down to the base. Seads medium to large. Average yield 350 lbs. Oil content 48-49 per cent. (moisture-free basis). Seed rate 20 lbs. for a pure crop. Togari is a very suitable inter-crop with these castors. All cane fields may have a row of these at their margins.

# SELECTIONS

## *Cryptostegia grandiflora* R. Br. (Asclepiadaceas)— A Promising Short-Term Rubber Vine

Rubber is one of the most essential requirements in the modern civilized world. It is not only a necessary commodity in times of peace but is an essential and indispensable necessity in times of war, where mechanised armies travel on rubber and the building of the modern weapons of warfare would have been impossible without it. Rubber is primarily a vegetable product. Though it is obtained from several species of plants, the chief source of rubber of commerce is the Para Rubber tree *Hevea braziliensis* M. Arg., which is a native of Brazil and other South American countries. It is from here that the plants spread to Ceylon, Burma, Malaya, French Indo-China, Dutch East-Indies and other Pacific Islands, where it is planted on extensive areas. The area under rubber in our country is very limited and at present chiefly confined to parts of Travancore, Cochin and Malabar. Owing to the great demand for rubber that is felt at the present day, various attempts are being made for an immediate increase in the output of rubber in this country. The rubber tree, *Hevea braziliensis* M. Arg., yields rubber only after six or eight years of growth and hence an immediate increase in the output of rubber production by planting more of these trees is not possible. Morever, for successful plantation of this species a heavy humid and warm tropical climate with a fairly heavy rainfall, as is obtained in Travancore, Cochin and parts of Malabar, are essential. These facts, therefore, necessitated the search of other sources for obtaining rubber almost immediately. Two lines of investigation present themselves. The first is the search for such plants as would produce rubber and that might be existing in the jungles in abundance and which could be tapped for rubber almost immediately. The second is the finding of quick-growing plants with rubber content that could be cultivated on a large scale and rubber extracted within a short time, almost the same year they are planted.

Preliminary investigations on this problem were carried out very recently at the Agricultural Research Institute, Coimbatore, at the instance of the Madras Government. A large number of latex-bearing plants have been tested for their rubber content. In most cases the latex (milky juice) could not be coagulated by any of the common methods known. In a few instances, the latex was coagulated, but the resulting substance was very high in resin content and consequently too sticky to be useful as rubber or rubber substitute. One plant alone, *i.e., Cryptostegia grandiflora* R. Br., has given very satisfactory results so far. This plant is very rich in latex and the latex was easily coagulated by dilute acetic acid and the rubber thus obtained was of a very good quality, very nearly equal to Para Rubber in its physical properties.

*Cryptostegia grandiflora* R. Br., is an attractive woody climber and when allowed to grow by itself without support, attains a beautiful bushy growth of about ten feet high. If allowed to climb on other trees, it grows up to the very top and spreads over on all sides. The plant is very conspicuous with its large showy rosy flowers and fairly big triangular fruits in pairs without stalks. Each fruit (follicle) is about five inches long and from one inch on each of the three faces gradually diminishes to a point towards the free end. The fruits, when ripen, dehisce by means of longitudinal slits along the middle of the outer triangular face liberating a large number of small flattened wedge-shaped seeds which are provided with long silky hairs, with the aid of which

they float in air like parachutes and are carried to considerable distances from the parent plant. This plant is a native of tropical Africa and was introduced into this country many years ago and has become more or less naturalised. It is said to occur in this Province but its exact distribution and extent are yet to be ascertained. Investigations are under way as to the best method of propagation of this plant on a large scale, its growth habits, latex-producing properties, best method of extraction of latex, the methods of coagulation of the same, etc., with a view to finding out the possibility of its being grown as short-term rubber crop.

S. N. Chandrasekhara Ayyar and T. V. Reddy,
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## Vegetable Seed Production in India

One of the effects of the war has been to interrupt the supply of vegetable seeds to India. Large quantities of these seeds used to be imported from the United Kingdom, the United States of America, Australia, France, Italy and Germany. It is, therefore, essential to produce in India as much vegetable seed as possible. If vegetable seed production can be put on a sound basis now, it may well become a new industry for India in post-war conditions. The need for producing vegetables on a large scale hardly needs emphasis. They are essential 'protective' foods supplying particularly vitamins A and C, and in certain cases also B.

Of certain vegetable seeds there has always been a fair supply in India. Onion seed has for many years been produced both in the Bombay Presidency and in Bihar. In the villages round about Delhi, cauliflower seed has been produced for decades and appears to be completely acclimatized. Foreign cauliflowers do not seed satisfactorily at Delhi. The tomato naturally produces seed wherever it grows throughout India and the only difficulties with its seed production are: (1) to make certain that the variety is not cross-fertilized with others and so degenerate, and (2) to use the right technique for seed extraction and drying.

There is no difficulty either in getting the seed of a large number of well-known Indian vegetables. The difficulties mainly arise in connection with cabbage, lettuce, turnip, carrot and beetroot.

### Importance of Climate

The first important requirement for the production of seeds of these vegetables is a suitable climate. Generally speaking, high temperatures are detrimental. During the growing period, the conditions should be cool and moist. During the ripening period bright sunny but not excessively warm conditions are required. Where there is wind, heavy rain or hail at the time of ripening, it is unlikely, even if other conditions are favourable, that seed-production will be a success. Individual plants and localities have their own peculiarities. Cauliflower will not set seed in Kashmir, nor will cabbage set seed in Coorg.

The Valley of Kashmir with its altitude of 5,000 ft., and its almost European climate unaffected by the monsoon is ideal for the production of most kinds of vegetable seeds. The Kashmir Agricultural Department produces vegetable seeds on certain of its farms. Various private growers assisted by that Department have either started special small farms for vegetable seed production or are running seed production as a side-line on bigger farms along with fruit and vegetable growing for the market.

The writer has also seen successful production of vegetable seed at Kalimpong in the Darjeeling district of North Bengal, also at about 5,000 feet. But there it is essential to sow early so that the flowering heads are not caught by the beginning of the rainy season before the seed has ripened. Generally speaking, we may say that, in addition to Kashmir, areas of about 5,000 feet elevation in the Himalayan foothills where it is possible to ripen off the seed without interference by rain or hail ought to be suitable for vegetable seed production.

## Special Methods

We may now consider the special methods required in the case of one or two individual vegetables. Briefly the principles are: (1) to select first-class plants as parents, (2) to transplant these in the beginning of winter—a procedure which gives the vegetative growth a necessary check and helps to induce flowering, (3) to prevent cross-pollination, and to eliminate plants which look different from the type and may be the results of accidental crossing, (4) to harvest carefully at the right time and then to dry gradually and completely before bagging and despatch.

*Cabbage.*—In Kashmir, the seed is sown in August. In December the plants are transplanted 2 ft. by 1½ ft. apart. The seed is ready in July. In areas subject to the monsoon, transplanting would have to be done earlier, so as to get fruiting not later than April.

Normally the cabbage head cracks to let the seeding branches through, but if this is delayed, it may be necessary to make two transverse cuts in the upper leaves of the head, taking care not to injure the heart where the main growing shoot is hidden. The four segments can be gently separated a little and the flowering branches will come up through the cuts.

It is also possible to get seeds from the stumps of desirable cabbage plants from which the heads have been cut off and marketed. These stumps produce new growths. Some of these growths may develop into small cabbages and others into seeding branches. There is, however, a belief that seeds from such branches do not produce compact heads when sown.

The cabbage seed should be harvested when the pods are turning yellow and beginning to split.

The pods should be dried, lightly threshed, the seed separated by screening and dried once more before storage or despatch. Cauliflower and knol kohl can be treated like cabbage. There is no need to make cuts in the heads of these vegetables. The worst enemy of all these crops is the aphis, a small sucking insect which takes the juice out of the leaves and may cause a failure of the seed crop. The remedy is regular spraying with a soap-tobacco solution.

*Carrot.*—In Kashmir, the general procedure is the same as for cabbage, *i.e.*, sow in August, sprout and transplant in December 1½ ft. apart each way. A small portion of the taproot is removed. The root is then buried up to but not including the crown. The harvesting is done in July. When choosing mother-plants, deformed or forked roots should be rejected and those with plenty of red eatable cortex and little of core should be selected. When transplanting carrots which are intended for seed, the leaves should be trimmed back to the growing point which itself should remain unharmed.

*Lettuce.*—Vigorous maturing plants with well-developed heads should be chosen and all others removed. Trasplanting is not necessary. Sowing should be done (as in the case of the previously mentioned vegetables) so that seed maturing occurs in the spring. The seed is very light and has a small tuft of hair on it, so that it may be blown away by the wind. Any branch showing the beginning of ripeness ought to be harvested rapidly at once.

*Beet and Turnips.*—The procedure is similar to that for carrots.

*Onions.*—In areas where the onion does seed, parent bulbs are selected for earliness and good shape and can either be left where they are or else transplanted after storage. The seed takes a fairly long time to develop. Individual seed-heads should be harvested with about 6 in. of stalk for hanging them up to dry.

*Tomato Seed.*—Let the fruits ripen fully on the plants. Then remove the fruits and crush them in a wooden or earthen tub without water for a day or two, stirring frequently. The mass ferments and the seeds settle. Pour off the fermented mass, take out the seeds, wash them, spread on trays in the shade and stir now and again till dry.

*Brinjal Seed.*—The procedure is as for tomatoes, but it is necessary to remove the skin and much of the flesh of large varieties.

The following is an indication of the amount of seed that is required to sow an acre of certain vegetables for seed production and the amount of ripe seed that may be expected per acre.

| Name of vegetable | Quantity of seed required, per acre in lb. | Average produce of seed per acre in lb. |
|---|---|---|
| PLAINS | | |
| Beans Dwarf French | 60 | 450 |
| Cauliflower local | ½ | 120 |
| Lettuce Cabbage and Cos varieties | 3 | 250 |
| Onion local variety | 5 | 260 |
| Peas garden variety | 60 | 750 |
| Radish English variety | 10 | 150 |
| Spinach local variety | 8 | 350 |
| Tomato English variety | ½ | 80 |
| Turnip local variety | 2 | 300 |
| HILLS | | |
| Beetroot | 4 | 250 |
| Cabbage | ½ | 160 |
| Carrot | 3 | 200 |
| Knol kohl | 4 | 200 |
| Leek | 5 | 75 |
| Turnip | 3 | 120 |

It is essential for a would-be seed producer to concentrate on one or two vegetables, which do not intercross, and on one good commercial variety only of each vegetable, to ensure purity and avoid cross-fertilization and consequent deterioration. He must select the best plants rigidly and multiply from these only. A seed grower who can obtain and retain a reputation for quality has created for himself the greatest asset—a good name. Buyers will return to him year after year.

### Prices and Profits

The vegetable seed grower, who must perforce be a fairly intelligent and well-educated person, ought to be able to look after himself in the way of fixing prices for the seed rather better than the uneducated cultivator who has to depend entirely on the village *bania* as his main buyer. Normally, a seed-grower will be selling to seedsmen or seed-selling companies whose business it is to retail seed to the public. In the case of many retail firms a large amount of their costs is for advertising. The following table gives some idea of the range of wholesale and retail prices:—

| | Cabbage | Lettuce | Onions | Cauliflower | Tomato | Turnips | *Knol kohl* | Carrot |
|---|---|---|---|---|---|---|---|---|
| Prices in shillings per lb. guaranteed to seed growers producing vegetable seed on contract for the Government of New South Wales (1942) | 10*s.* | 6*s.* | 17*s.* 6*d.* | 30*s.* | 20*s* to 30*s.* | | | |
| Prices per lb. obtained by a private seed farm in Kashmir (1942) .. .. .. | Rs. 20 to 25 | Rs. 9 | Rs. 2 | Rs. 20 Jammu | Rs. 9 to 25 | Rs. 4-8 | Rs. 4-8 | Rs. 6 |
| Prices quoted for South African seed in shillings per lb. (1942) | 15*s.* to 25*s.* | | 15*s.* to 17*s.* 6*d.* | 22*s.* 6*d.* to 25*s.* | 15*s.* to 17*s.* 6*d.* | | | |
| Firm A (India) 1942 seed list | Re. 1 to Rs. 2 per oz. | Re. 1-2 to 1-12 per oz. | Re. 1-8 per oz. | Rs. 2 to 2-8 per oz. | | As. 12 to Re. 1 per oz. | | Rs. 1-8 to 2-4 per oz. |
| Firm B (India) 1939-40 seed list | Cape-cabbages Rs. 20–32 per lb. Others Re. 1-4 per oz. | Rs. 8 to 14 per lb. | Rs. 8 to 18 per lb. Indigenous seed Rs. 5. | Rs. 40 to 72 per lb. Patna Rs. 28 per lb. | American Rs. 7 to 11 per 4 oz. Eng. Vars. Rs. 8 to 22 per lb. | Rs. 4-8 to 6 per lb. | Rs. 8 to 12 per lb. | Rs. 6 per lb. (Country carrot Rs. 2 per lb.) |
| Firm C (India) List undated | As. 4 to Re. 1-4 per oz. | As. 12 per oz. | Indian As. 4-6 per oz. Others Re. 1-8 to 2 per oz. | Re. 1-4 to 2 per oz. Indian | Rs. 1-8 to 2 per oz. | As. 4 to 8 per oz. | Re. 1 per oz | Re. 1 to 1-4 per oz. |
| Bangalore Government Botanic Garden, Lal Bagh (undated) | As. 6 per oz. | | | | | As. 2 per oz. | | As. 4 per oz. |

# Soil Erosion and Its Cure in the Punjab

BY

**H. M. Glover**

[The original pamphlets by H. M. Glover, I.F.S., Chief Conservator of Forests, Punjab, are illustrated with typical photographs and are accompanied by catching forewords by F. L. Brayne, Financial Commissioner, Development.]

## I

### Hoshiarpur Chos

Many years ago the Siwalik hills of the Hoshiarpur District were covered thickly with forest and below the hills lay some of the most fertile fields of the whole Punjab. The Rajas and Sardars kept the forests as *Shikargahs* and no village goats or cattle were allowed therein. There was no erosion: trees, bushes and grass grew in abundance and water flowed from the hills into the plains. Wells were numerous and water was plentiful. No one kept more cattle and goats than he could maintain on or near his own land as the country was lawless and robbery was rife. The advent of the British brought peace and prosperity to the countryside.

The British did not know what to do with the forests, so they included them in the village *shamilat* and the people were delighted with the change. They cut down the forests, their cattle grazed wherever they wanted to, goats and sheep multiplied a hundredfold and from far and near *gaddis* brought their flocks to the Siwaliks. The trees were cut for fuel and animals grazed the bushes until there was no cover on the ground. The heavy monsoon rain then washed away the soil until streams of sand, locally called *Chos,* poured over the cultivated fields and destroyed them. Thousands and thousands of acres were covered with sand brought down from the hills and it was realised that the destruction of the forests had meant the ruin of the peasants.

In 1900 a special *Chos* Act was passed and from the greater part of the southern face of the Siwaliks goats and sheep were evicted after the payment of compensation to the owners.

Of later years Government, through the agency of the Forest Department acting in close collaboration with the Revenue and Co-operative Departments, has made very special efforts to prevent and cure erosion. In April 1939 a special Circle of the Forest Department was created. The officers and subordinates of the Soil Conservation Circle are specially chosen on account of their tact and suitability for getting on well with the people. They must be good 'mixers', able to persuade the people to accomplish by voluntary effort what would be impossible by compulsion. The forests have to be closed to grazing in order that grass, bushes, and trees shall grow again, and that means restrictions on the movements of animals which involve a certain amount of inconvenience. Grass grows apace in the closed areas and is sold at a large profit by the villagers who, in fact, benefit far more from the use and sale of grass than they did from free grazing. The violence of the *Chos* has decreased, and already the owners of land in the plains are attempting to reclaim fields from the sandy beds of *Chos* and are clamouring for Government to bring pressure on the people of the hills to close to grazing the rest of their *shamilat.*

## II

### Cultivated Uplands of the North Punjab

Between the Jhelum and the Indus rivers in the districts of Jhelum, Rawalpindi and Attock are cultivated uplands bordering on the Salt Range, the Margalla and the Kalachitta Hills.

These uplands are drained by the Indus and Jhelum rivers and their tributaries, which lie much below the general level of the country. Long ravines down which storm water rushes after heavy rain cut back into the cultivated fields. Wherever the fields have not been terraced and embanked, the valuable top-soil is washed away and after a few heavy storms the fields become full of gullies and are not worth cultivating. Millions of tons of good fertile earth have been carried away and the land has been rendered sterile and unproductive. The problem is to discover what to do with such lands, and how to reclaim them at any reasonable cost.

The rainfall is only 25 inches a year, and all of it is needed to fertilize the land. In the winter the rain falls with a regularity sufficient to permit the growth of wheat and barley, but the bulk of the rain falls in the summer monsoon when fodder crops and pulses are grown. Thunderstorms are frequent and during them the rainfall may be very heavy indeed, so the problem is not only to conserve such rain as falls but also to provide an adequate escape for flood water.

Conservation of the rain water is secured by terracing the fields and embanking their lower edges, the rain water being restrained from pouring down the slopes by peripheral ridges called "watts".

Individual effort is not sufficient, as frequently the efforts of one man to preserve his fields are ruined by his negligent neighbour from whose untended, unterraced fields storm water pours, gathering force until it destroys the good fields below.

We will now see how the land is reclaimed.

### Co-operative Land Reclamation Societies of the Gujar Khan Tehsil

In united effort lies the secret of success; the whole of the lands of one catchment area must be terraced, embanked and drained before they are safe from erosion. Soil conservation has become the duty of the Forest Department which now gives expert advice on the reclamation of eroded cultivated lands as well as on the improvement of village forests and grazing grounds. The Forest Officer organizes the work of land reclamation, in close association with the Revenue, Agricultural and Co-operative Departments.

The villagers of the Gujar Khan tehsil are industrious small holders ready to work hard and to work together to put their lands in order. Their fields were in terribly bad order.

Individual owners had endeavoured to reclaim their lands in the past, and occasionally dams and weirs have been built to get rid of the storm water and to prevent the ravines eating back into the fields. But there had been no united effort, and sooner or later the terraces had broken down and the dams had gone out of repair.

Fortunately the Co-operative Department has already proved its worth in this tehsil and the Forest Officer found a popular agency in the Co-operative Land Reclamation Society for organizing the common efforts of the villagers to reclaim the land. The cardinal principle is to start terracing, levelling and embankment, or *watbandi* at the water-shed and to work gradually downhill. It is quite useless for a man at the bottom of the valley to put his fields in order when water is still liable to rush down the slopes.

The soil is an alluvial loam overlying less fertile sands, clays and sandstones and is of a consistency sufficient to form nearly verticle banks where terraced, and when the rains have soaked into the ground and rendered it soft and easily worked, numbers of villagers assemble with their bullocks and *karrahs*, or huge rakes, drums are beaten and fields are terraced and 'watted' at an amazing speed. 'Many hands make light work'; the scene is very like a village fair, and every one enjoys himself.

Until the uplands have been terraced and 'watted' the rush of storm water is uncontrollable. But once the upper slopes have been dealt with, the ravines themselves can be tackled.

The beds of the main ravines are blocked by masonry weirs, often of considerable size, in order to check the run-off of storm water, and smaller stone weirs are built in side ravines. Behind these weirs silt accumulates and very fertile fields are formed. The weirs enable the storm water to drain away without damage to the soil of the cultivated fields.

For the weirs Government make a contribution to the Society of about Rs. 500 per unit of 300 to 500 acres. The villagers give their labour free of charge, and up to date this has amounted to an average of Rs. 6,500 per society.

Nothing succeeds like success, and the example afforded by five or six flourishing Co-operative Land Reclamation Societies has induced more than two dozen other villages to apply to the Forest Officer for assistance.

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## Science at the Service of Soviet Agriculture, 1939

BY

**N. Tsitsin**

*Order of Lenin. Member of the Academy of Sciences. Member of the Supreme Soviet of the U.S.S.R.*

*(A chapter from the book, "Russia Speaks for Itself—Agriculture Transport"*

Two conceptions more remotely related than peasant farming and agricultural science could hardly have been found in old Russia. The peasants jogged along as best they could without the aid of science or any prospect of receiving it. Only after the establishment of Soviet government did agriculture develop into a concerted effort for high crop yields, with the State directing and supporting it as a prime duty. In a comparatively short time all conditions have been created in the Soviet Union for the unrestricted development of agricultural research on a scientific basis. There are now over 14,000 scientists at work in agricultural research.

In the Soviet Union there are 90 agricultural research institutes, 367 experimental stations and 507 experimental farms with numerous branches, whereas in tsarist Russia institutions of this kind could have been counted on one's fingers. But that is not all. Bearing notable witness to the tremendous interest of the Soviet peasantry in scientific agriculure, there are about 20,000 small but efficient laboratories functioning on the collective farms (*kolkhozes*). It is not difficult to imagine on what fertile soil falls every scientific discovery and innovation.

In 1938 seventy per cent. of the area under grain in the collective farms and State farms was sown with high-grade seeds.

The State has organised 1,547 experimental farms for the testing of cereal seeds in all parts of the country. Furthermore 693 agro-chemical laboratories have been organised by the machine and tractor stations.

In the U.S.S.R. no scientific discoveries are left to grow cobwebs. They are immediately put to exhaustive tests and practical use. It is easy to imagine what a great incentive to scientists is thus provided.

For instance in the spring of 1936, the All-Union Institute of Seed Selection and Genetics sent a newly-evolved variety of spring wheat ("Lutescence 1163") to a large number of collective farms for propagation. The members of the "Fifty-first Perekop Division", Kolkhoz (Odessa region) received 6½ lbs. of seeds for their laboratory. They proceeded with enthusiasm to their

propagation. This half peck of seed produced a yield of 13½ cwts. in the first year. In 1937 the kolkhoz collected a harvest of 167 cwts. from the new variety of spring wheat. And a year later "Lutescence 1163", which has proved to be the highest yielding grain in the southern districts, held dominion over 2,470 acres in this farm.

Rapid developments are being made in the theory of controlling vegetable life to reform inherited characteristics for the benefit of agriculture.

The late I. V. Michurin, a member of the Academy of Sciences, working in the same field as Luther Burbank, proved that under suitable conditions young hybrid seedlings can be trained to develop any desired characteristics.

Michurin took hardy wild plants from Siberia, Canada and various mountain regions and crossed them with delicate southern plants. The cross-breeds so obtained inherited all the hardihood of the wild flora: resistance to frost and drought and immunity to disease. On the other hand, they resembled their delicate parents of the south in tastiness, brightness of colour, largeness of fruit, and other desirable characteristics.

In this way Michurin bred a large number of remarkable varieties of fruit, among which we might mention the Belfleur Kitaika apple, the Krasa Severa cherry and the Michurin Beurré.

As a result of a number of interesting and original experiments he also succeeded in hybridizing the cherry and bird cherry, the peach and the almond, the apricot and the plum, and many other fruits.

Altogether Michurin evolved 300 valuable varieties of fruit.

Michurin's work has found many followers. Michurin orchards and Michurin clubs have sprung up in all parts of the country.

Year by year grapes and peaches, pears and lemons continue their triumphal advance to the north, ever spreading to new territories. In the R.S.F.S.R. alone about 10,000,000 Michurin trees will be bearing fruit by 1940. The fruit gardens of the U.S.S.R., covering an area of 3,211,000 acres, produce more than twice as much as pre-war.

Apart from State-owned orchards there are large kolkhoz orchards supplying the market. The district of Genichesk, Zaporozhye Region, where, in 1917, there were neither orchards nor vineyards, now has 1,069 acres of orchards and about 1,000 acres of vineyards.

Michurin's labours have introduced important new factors in the development of citrus plants and other sub-tropical crops. Now in the coastal regions of the West Caucasus new plantations of oranges, lemons, tangerines and tea are being developed year by year. Sunny Georgia is becoming the supplier of citrus fruits for the whole country.

In 1938 over 250,000,000 of the oranges and lemons placed on the market were grown on State farms and collective farms. By 1940 the Georgian republic will have 50,000 acres under citrus fruits.

Trofim Lysenko, member of the Academy of Sciences, is another outstanding scientist whose work has greatly assisted the development of Soviet agriculture. He is the author of the theory that the development of annual plants proceeds by stages. The first and second of the stages he found to consist in reaction to temperature and light respectively, and upon these he concentrated.

From these studies Lysenko evolved a new process in scientific temperature before planting. The experience of tens of thousands of farms has shown that as a result of vernalization the seeds sprout two or three days earlier. while the yield increases by an average of 90-180 lbs. per acre.

The vernalization of grain crops is practised on a wide scale in the U.S.S.R. In 1938 the area under vernalized grain reached 24,700,000 acres, and this year's plan (1939) is 35,748,000 acres.

The vernalization of sugar beet, potatoes, cotton and other crops is also widely practised in the U.S.S.R.

Lysenko has also devised new methods of selection. Using these

methods he has produced in the space of two and a half years excellent varieties of spring wheat in the Odessa region. With his colleagues, Lysenko has devised a method of improving the seeds of self-fertilizing plants by interbreeding and nursing them on seed plots.

The farms using these improved seeds gain an extra yield of 134 to 178 pounds per acre.

The writer himself is working on cross-breeding cultivated plants with extraneous wild grasses. We have made many successful experiments in crossing wheat with couch grass, and have discovered the varieties of this very common weed that cross with wheat. In 1930 I produced the first hybrids of wheat and couch grass. This led to the novel hypothesis that a new variety of plant, non-existent in nature, might be obtained—perennial wheat. In 1934 the first families of perennial hybrid wheat, Nos. 34085 and 23086, were selected. They proved my theory.

These perennial wheats have the unusual power of growing again after reaping. It has been demonstrated under experimental conditions, with three years' continuous vegetation, that these hybrids yield seven or eight harvests from a single sowing.

At the present time perennial wheat is being tested by our farmers. Even under the unfavourable climatic conditions of 1938 in the Moscow Region perennial wheat yielded as much as 19 cwts. per acre. Perennial wheat also has exceptional drought-resisting properties.

In addition to these perennials, annual forms of the same hybrid have been evolved with numerous valuable properties and characteristics of their own.

At an experimental station in Vorochilovask (North Caucasus) the agronomist, Derzhavin, is working on important experiments towards hybridising a variety of hard wheat with perennial rye. He too has evolved a triennial wheat.

My theory that every agricultural plant can be matched with a wild one has become a principle guiding many research workers.

The results of these studies in wheat-breeding, so wide and diversified, have already been put to practical use in Soviet agriculture.

Wheat, like Michurin fruits, is being grown further and further north and spreading over wider areas every year.

In the old days the central regions of Russia proper grew nothing but rye. Wheat bread was rare delicacy on the table of the Russian peasant, and was regarded as a sign of prosperity.

At the present time wheat is being sown in a large number of new regions. Even where the climate is severe for wheat, there are no peasants who go without white bread.

The conquest of the Arctic, the discovery of new deposits of coal, apatite, iron and other economic minerals in the far north of the country have led to the population of uninhabited districts and created a demand for local farm produce.

In this direction useful work is being done by the Arctic experimental station of the All-Union Institute of Plant Growing, directed by Academician Richfeld. This polar station has evolved new kinds of barley, oats, vegetables, fodder grasses, potatoes and other edible roots suitable for cultivation in the far north.

In the Republic of Yakutia, with its perpetually frozen soil and brief dry summer, the kolkhoz farms, by employing advanced agrotechnical methods and cultivating the soil with tractors, are getting good harvests regularly. For instance, the Orjonikidze Kolkhoz, in a district where the annual mean is 9° C., grows 22 tons of cabbage to the acre.

Before the October Revolution there was no hothouse farming in the Far North. Now there are 73,000 hotbeds and 451,920 sq. feet of greenhouses. On the shore of the Kola Strait, near Latitude 70° N., the collective fisheries

"Tarmo" and "Taisto" obtain over 8 tons of potatoes and sixteen tons of other edible roots to the acre. In 1938 the "Industria" State Farms in the Murmansk region harvested 12,792 cwts. of vegetables, about 28,000 cwts. of potatoes, thousands of centners of edible roots and tens of thousands of centners of hay. Apart from sowing in the open field this State farm also has a large area under glass, which in 1938 yielded 436 tons of vegetables.

The growing of greens in the open air has now become practicable right up to the shores of the Kara Sea and the Siberian coast of the Arctic Ocean.

Soviet agricultural science has been highly successful in naturalizing crops in new localities. The Kuban is now growing rice, while the North Caucasus and the Ukraine are growing cotton.

New sugar beet districts have been developed on the Kuban, in the Saratov region, the Altai territory, and other parts of the country. By 1937 the area under cotton in the U.S.S.R. had reached 701,480 acres, and in the Ukrainian S.S.R. 553,280 acres.

The great emigration of crops to the north of the country was undreamed of by agronomists in the old days. It has become possible due, largely, to the fruitful labours of Soviet scientists in genetics, selection and seed farming. The U.S.S.R. has the most northern cotton plantations in the world, extending to 48° N.

In Azerbaijan (Cacausus) and Turkmenia (Central Asia) new varieties of Egyptian cotton have been produced and are already being cultivated in the collective farms and State farms. These varieties are extremely fertile and ripen early.

In 1930 the plantations of Egyptian cotton in the U.S.S.R. covered a total area of only 11,830 acres. In 1938 Egyptian cotton was being grown over an area of 339,748 acres.

Highly fertile varieties of American cotton, with a long fibre, have been evolved by selection and are becoming widespread.

The Odessa Institute of Selection and Genetics (directed by Academician Lysenko) has bred two new fertile and early-ripe varieties of cotton (OD-1, OD-2) growing a long fibre. This year 50,000 acres of land will be planted with these varieties.

A number of successful experiments have produced several new varieties of sugar beet with a high sugar content and other valuable properties.

Soviet selection experts have also evolved highly fertile varieties of potato. For the first time in the history of the science of selection, the Potato Institute has produced a variety (No. 8670) that resists parasites (*phytophthora*). With the help of the collective farms this institute in four years obtained 11,500 tons of potato from 20 beds planted with "8670".

Lysenko has also elaborated a method of planting potatoes in summer, which has revolutionised the development of this culture in the steppes of the U.S.S.R. Formerly planting stock in the south had to be completely renewed every two or three years with seed potatoes from districts further north. This was regarded as the only method of preventing potatoes from running to seed in a southern district like Crimea, where the crop scarcely recompensed the farmer for what he had sown. Summer planting put an end to this. The collective farms and State farms in the south now obtain good crops regularly every year. For instance, the "Chervonny Kazak" Kolkhoz in the Jankoi District of the Crimea increased the yield to ten and a half tons per acre by using Lysenko's method.

Great progress has been made by Soviet scientists in the protection of plants against pests and blights.

Especially wide use is made of *Oöphagous trichogramminæ* to combat destructive moths and grubs. Hundreds of special laboratories for the breeding of *trichogramminæ* have already been organised on kolkhoz farms.

One of these laboratories, directed by collective farmer Moskalenko of the "Shylakh Lenina" Kolkhoz, Yampol District, Vinnitsa Region, Ukraine, bred 37,000,000 of these insects, which afterwards rid an area of 914 acres of destructive moths.

Soviet research laboratories have discovered a number of viruses for use in combating various agricultural pests and diseases.

Great progress has also been made in the field of agrochemistry. Academician Pryanishnikov has discovered the principle of using ammonia salts as fertilizer.

In recent years leading collective farmers, State farm employees and managers of kolkhoz laboratories have been experimenting with the "dieting" method, that is, dosing crops with fertilizer at various stages during the vegetation period. At the present time this method is being used on huge areas, particularaly those under industrial crops.

In tsarist Russia the outlay of potassium fertilizer was something less than a teaspoonful to the acre.

In the U.S.S.R. mineral and natural fertilizers are used in vast quantities. In 1937 ninety per cent. of the beet fields and cotton plantations were enriched with mineral fertilizer. At the same time there is a constant increase in the general distribution of manure.

In 1937 the chemical industries of the U.S.S.R. supplied the countryside with 2,798,000 tons of mineral fertilizer, as against 230,000 tons in 1913.

Among the great achievements of Soviet agricultural science we must also count the introduction of bacterial fertilizer—Nitragin—for various bean cultures, and the invention of a bacterial fertiliser—"Azotogen"—for cereals, industrial crops and vegetables. Experiments have shown that this fertilizer increases harvests by as much as 20 and 30 per cent.

The Tractor Institute and a number of tractor plants have designed and built tractors powered with Diesel engines and gas producers, which, as tests have shown, run at a low cost and give long service without repairs.

The Institute of Scientific Sowing has designed machines for sowing in close drills. When sown in the usual way plants often grow in adverse conditions, are ill-nourished, stifled by their neighbours and stunted in development. The new seeders will make it possible to distribute the plants more rationally, so as to guarantee, as for as possible, a place in the sun for all. New types of seeders have been invented for grain crops, sugar beet and other industrial crops. In 1939, 2,717,000 acres were sown with these close seed drills.

Under the first Five-Year Plan much was done in theory and practice to improve grain harvester combines. Special attachments were devised for collecting sunflowers, castor oil plants, millet and other crops.

Soviet inventors have devised a special harvester combine for collecting grain crops in the humid conditions of the northern districts. Hundreds of these special "northern" combines were employed during the harvest last autumn. Soviet engineers have also designed machines for the planting, cultivating and picking of potatoes, sugar beet, flax, cotton and other crops laborious to farm.

No less progress has been made by Soviet scientists in the field of livestock breeding. Unfortunately, lack of space does not allow me to dwell in detail on this department of farming. I might mention the work of Academician Ivanow, who is breeding valuable hybrids, notably the Askana Rambouillet and a new breed of pig—the Ukrainian White.

The All-Union Institute of Animal Breeding has developed a method and technique of inseminating animals artificially, so as to make the maximum use of valuable males.

In 1938, 1,536 cows were inseminated from one bull and produced 1,490 calves; 15,016 sheep were inseminated from one ram and produced 15,662

lambs. By 1938 fifty million farm animals had been inseminated artificially in the Soviet Union.

Whatever branch of agriculture we take we find thousands upon thousands of collective farm experimenters working shoulder to shoulder with scientists in search of new methods, new discoveries.

This movement of innovators, boldly and rationally transforming nature, is becoming a real mass movement, a movement of the people. This is seen from the fact that at the All-Union Agricultural Exhibition of 1939, which will exhibit only the best of the best, 160,000 to 200,000 collective farms, State farms, machine and tractor stations, collective farm brigades and teams will be represented—real enthusiasts and front-liners of Socialist agriculture.

This close contact between Soviet science and the people allows our men of science to go boldly ahead with their experiments, enriching the collective farms and State farms with a wealth of modern scientific discovery.

Much has been and is being contributed to science by the practical experience of the collective farmers. Soviet academicians and professors, all our leading scientists, make these contributions the basis of their work in the service of Soviet science and the Socialist farms of the U.S.S.R.—the country of large-scale agriculture unmatched in the world.

Ivan Michurin often said: "We can expect no favours from Nature; our job is to take them."

In the U.S.S.R. thousands of people are taking part in the great duel with Nature, in a true spirit of innovation, enthusiasm, pertinacity and research. That is why the reorganisation and renewal of the countryside in the Soviet Union has, in the space of twenty-one years, produced such astonishing results.

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